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(54)【発明の名称】 タイヤ空気圧異常検出方法および装置

(57)【要約】

【目的】 低コストでかつ信頼性が高く、しかも全輪同時の異常の検出も可能となる、タイヤ空気圧異常検出方法を提供する。

【構成】 各ホイールの角速度を検出する工程、検出された角速度に比例した信号を発生する工程、1輪のみの空気圧を直接検出する工程、検出された空気圧に比例した信号を発生する工程、および前記工程で発せられた信号を演算処理する工程からなるタイヤ空気圧異常検出方法およびそれに使用する装置。

【特許請求の範囲】

【請求項1】 (a) 各ホイールの角速度を検出する工程、(b) 検出された角速度に比例した信号を発生する工程、(c) 1輪のみの空気圧を直接検出する工程、

(d) 検出された空気圧に比例した信号を発生する工程、および(e) 前記工程(b)および工程(d)で発生された信号を演算処理する工程からなり、前記工程

(e)が、空気圧が直接測定される前記1輪に関しては、その空気圧が予め定められた正常値と比較して0.3 kg/cm²以上の差があればそのタイヤの異常を警告する装置を作動させ、前記1輪の空気圧が正常なばあいには、その他の車輪についてその角速度の前記1輪の角速度に対する比が、正常な空気圧における前記1輪の角速度を基準とした正常時ホイール角速度比テーブルの値と比較して0.05%から0.60%の差があればいい、またはその角速度が全車輪の角速度の平均値と比較して0.05%から0.60%の差があればいいにそのタイヤの異常を警告する装置を作動させる工程であることを特徴とする車輛のタイヤ空気圧の異常を検出する方法。

【請求項2】 前記1輪の異常が警告されたばあいには、空気圧と角速度との関係を表示するテーブルから空気圧が正常であるばあいの前記1輪の角速度を求め、この角速度に対する他の車輪の角速度比を求めて、減圧した車輪を特定する工程(f)をさらに有する請求項1記載の方法。

【請求項3】 各ホイールの角速度を検出する角速度検出手段、検出された角速度に比例した信号を発生する角速度信号発生手段、1輪のみの空気圧を直接検出する空気圧検出手段、求められた空気圧に比例する信号を発生する空気圧信号発生手段、および前記角速度信号発生手段および空気圧信号発生手段から発生された信号を演算処理する演算処理手段からなり、前記演算処理手段が、空気圧が直接測定される前記1輪に関しては、その空気圧が予め定められた正常値と比較して0.3 kg/cm²以上の差があればそのタイヤの異常を警告する装置を作動させ、前記1輪の空気圧が正常なばあいには、その他の車輪についてその角速度の前記1輪の角速度に対する比が、正常な空気圧における前記1輪の角速度を基準とした正常時ホイール角速度比テーブルの値と比較して0.05%から0.60%の差があればいい、またはその角速度が全車輪の角速度の平均値と比較して0.05%から0.60%の差があればいいにそのタイヤの異常を警告する装置を作動させることを特徴とする車輛のタイヤ空気圧の異常を検出する装置。

【請求項4】 前記1輪の空気圧が異常であるばあいには、空気圧と角速度との関係を表示するテーブルから空気圧が正常であるばあいの前記1輪の角速度を求め、この角速度に対する他の車輪の角速度比を求めて、減圧した車輪を特定する特定手段をさらに有してなる請求項3記載の装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は乗用車、トラックなどの車輛のタイヤ空気圧異常の検出方法および検出装置に関する。さらに詳しくは、ABS(アンチロックブレーキングシステム)の車輪速度パルスを利用して低コストを実現しながら、1輪にのみ空気圧検出装置を設けるという最小限のコスト増で、2輪以上の同時異常も簡便かつ確実に検出できる方法および装置に関する。

【0002】

【従来の技術】タイヤの空気圧は車輛の性能に多大の影響を及ぼし、とくに空気圧の減少は安全に係わる問題である。このため、従来からタイヤの空気圧異常を検出する手段が数多く提案されてきた。しかしながら、これらの提案は実用化に際して高信頼性と低コストを両立させることが困難であったため広く普及することがなかった。近年、ABSの普及に伴いABSの車輪速度パルスを利用し、低コストかつ高信頼性を兼ね備えたシステムが提案されているが、該システムは1輪の異常に対しては信頼性を有するものの2輪以上の同時異常に対して不安を残している。

【0003】

【発明が解決しようとする課題】ところで、通常こうした空気圧異常を検出する装置は、検出の手段によりいくつかに分類される。1つは空気圧を直接に検知するタイプであり、もう1つは空気圧によって変化する物理量(たわみ量、回転数など)を検知するタイプである。

【0004】前者は信頼性において有利な反面、回転体から固定側への信号の伝達などの難しい問題があるため装置が複雑、高価になりやすい。また、後者は装置が単純、安価な代わりに信頼性に乏しい面がある。

【0005】またこうした車輪速から空気圧異常を検出するシステムでは、通常、正常輪の車輪速度パルスとの比較によって異常が判断されるため、少なくとも1本のタイヤの空気圧は正常でなければならないため、全輪同時の異常は理論的に検出することができない。

【0006】本発明は、叙上の事情に鑑み、低コストでかつ信頼性が高く、しかも全輪同時の異常の検出も可能となる、タイヤ空気圧異常検出方法および装置を提供することを目的とする。

【0007】

【課題を解決するための手段】本発明により、(a)各ホイールの角速度を検出する工程、(b)検出された角速度に比例した信号を発生する工程、(c)1輪のみの空気圧を直接検出する工程、(d)検出された空気圧に比例した信号を発生する工程、および(e)前記工程

(b)および工程(d)で発生された信号を演算処理する工程からなり、前記工程(e)が、空気圧が直接測定される前記1輪に関しては、その空気圧が予め定められた正常値と比較して0.3 kg/cm²以上の差があればその

タイヤの異常を警告する装置を作動させ、前記1輪の空気圧が正常なばあいには、その他の車輪についてその角速度の前記1輪の角速度に対する比が、正常な空気圧における前記1輪の角速度を基準とした正常時ホイール角速度比テーブルの値と比較して0.05%から0.60%の差があるばあい、またはその角速度が全車輪の角速度の平均値と比較して0.05%から0.60%の差があるばあいにそのタイヤの異常を警告する装置を作動させる工程である車輛のタイヤ空気圧の異常を検出する方法が提供される。

【0008】本発明の方法においては、前記1輪の空気圧の異常が警告されたばあいには、空気圧と角速度との関係を表示するテーブルから空気圧が正常であるばあいの前記1輪の角速度を求め、この角速度に対する他の車輪の角速度比を求めて、減圧した車輪を特定することができる。

【0009】また、本発明により、各ホイールの角速度を検出する角速度検出手段、検出された角速度に比例した信号を発生する角速度信号発生手段、1輪のみの空気圧を直接検出する空気圧検出手段、求められた空気圧に比例する信号を発生する空気圧信号発生手段、および前記角速度信号発生手段および空気圧信号発生手段から発生された信号を演算処理する演算処理手段からなり、前記演算処理手段が、空気圧が直接測定される前記1輪に関しては、その空気圧が予め定められた正常値と比較して0.3 kg/cm²以上の差があればそのタイヤの異常を警告する装置を作動させ、前記1輪の空気圧が正常なばあいには、その他の車輪についてその角速度の前記1輪の角速度に対する比が、正常な空気圧における前記1輪の角速度を基準とした正常時ホイール角速度比テーブルの値と比較して0.05%から0.60%の差があるばあい、またはその角速度が全車輪の角速度の平均値と比較して0.05%から0.60%の差があるばあいにそのタイヤの異常を警告する装置を作動させる車輛のタイヤ空気圧の異常を検出する装置が提供される。

【0010】本発明の装置は、前記1輪の空気圧が異常であるばあいには、空気圧と角速度との関係を表示するテーブルから空気圧が正常であるばあいの前記1輪の角

速度を求め、この角速度に対する他の車輪の角速度比を求めて、減圧した車輪を特定する特定手段をさらに有していてもよい。

【0011】

【作用】本発明においては、車輛の車輪のうちの1つについては、直接その空気圧を測定することにより減圧が検出され、他の車輪については前記1輪の角速度または全車輪の角速度の平均値に対する各車輪の角速度の相対値によって減圧が検出される。

【0012】

【実施例】以下、本発明の車輛のタイヤ空気圧の異常を検出する方法（以下、単に検出方法という）について各工程毎に説明する。

【0013】工程（a）においては、ABSから発せられる車輪速度パルスから、パルスカウンタなどの角速度検出手段を使用して各ホイールの角速度が検出される。そして、工程（b）において、D/A変換器などの角速度信号発生手段を使用してこの角速度に比例した信号を発生せしめ、各ホイールの角速度を常時モニタリングする。

【0014】工程（c）においては、圧力変換器などの空気圧検出手段を全車輪の中の1つに装着して、その空気圧が求められる。そして、工程（d）においては、直流増幅器などを使用してこの空気圧に比例する信号を発生し、常時モニタリングする。

【0015】工程（e）においては、まず、（d）工程においてモニタリングされている車輪A（前記空気圧検出手段が装着された車輪を車輪Aとする。以下同じ）の空気圧が、予め定められた正常値と比較して、0.3 kg/cm²以上の差があればそのタイヤの異常を警告する装置を作動させる。車輪Aの空気圧は直接的に測定されているため、全輪全ての減圧を含めて、車輪Aを含む任意の車輪の組の減圧が全て検出され、警告される。車輪Aのタイヤ回転角速度の空気圧・速度依存性を表1に示す。

【0016】

【表1】

表 1

	20 (km/h)	40 (km/h)	60 (km/h)	80 (km/h)	100 (km/h)	120 (km/h)
3.0 (kg/cm ²)	8.8680 (rad/sec)	17.7340	26.5994	35.4537	44.2984	53.1033
2.6 (kg/cm ²)	8.8737	17.7436	26.6124	35.4675	44.3191	53.1361
2.3 (kg/cm ²)	8.8816	17.7595	26.6364	35.4993	44.3544	53.1715
2.0 (kg/cm ²)	8.8940	17.7835	26.6692	35.5402	44.4018	53.2213
1.7 (kg/cm ²)	8.9093	17.8121	26.7077	35.5889	44.4574	53.2811
1.4 (kg/cm ²)	8.9208	17.8351	26.7409	35.6282	44.5026	53.3238
1.0 (kg/cm ²)	8.9358	17.8600	26.7765	35.6724	44.5596	53.4004

【0017】そして、車輪Aに関して減圧が認められないばあいには、工程(a)で求められた車輪Aの角速度と他の車輪の角速度との比が求められる。この比が予め作成されているテーブル値と比較して0.05%から0.60%の差があればそのタイヤの異常を警告する装置を作動させる。また、工程(a)で求められた全車輪の角速度の平均値を求め、車輪Aの角速度がこの平均値と比較して0.05%から0.60%の差があればそのタイヤの異常を警告する装置を作動させることとしてもよい。このようにして、車輪Aを含まない任意の車輪の組の減圧がすべて検出され、警告される。

【0018】警告はブザーなどの聴覚に訴えるものや、

ランプなどの視覚に訴えるものを用いて行なうことができる。

【0019】工程(e)においては、所定の角速度ピッチを定めてその範囲ごとに、正常な車輪Aの角速度に対する各車輪の角速度の比を記述したテーブルが必要であり、かかるテーブルは、正常空気圧で定められた速度毎に直進実走行を行ない、速度毎に角速度比を求めることにより作成することができる。このようなテーブルの例を表2に示す。表2の例においては、左前輪に空気圧検出手段が装着されている。

【0020】

【表2】

表 2

	20 (km/h)	40 (km/h)	60 (km/h)	80 (km/h)	100 (km/h)	120 (km/h)
左前輪 (FL)	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
右前輪 (FR)	1.00151	1.00151	1.00152	1.00152	1.00153	1.00153
左後輪 (RL)	0.99783	0.99776	0.99767	0.99756	0.99745	0.99732
右後輪 (RR)	0.99933	0.99927	0.99918	0.99908	0.99898	0.99885

【0021】以上に説明したように、本発明の方法によれば、4輪全ての減圧を含めて、任意の組の複数の車輪が減圧したことを検知することができる。そして、減圧が検知されたときに、減圧したのはどの車輪であるかの判定は、表1と表2とを併用することにより行われる。車輪Aの正常時の空気圧が2.0kg/cm²であるばあいの

具体的な動作例を以下に示す。

【0022】まず、車輪Aが正常であるか否かは、前述のように圧力変換器などによって空気圧を測定し、予め定められた正常値と比較することにより判断される。

【0023】そして、

1) 車輪Aの空気圧が正常であるばあい

工程（a）で測定された車輪Aの空気圧と工程（c）で測定された車輪Aの角速度とを用いて表1から車輪の速度を求める。そして、表2からこの速度における各車輪の正常時における角速度比を求める。

【0024】工程（a）で測定された各車輪の角速度を車輪Aの角速度で除して比を求め、さきほど求めた正常時における角速度と比較して、各車輪が正常であるか否かを判断することができる。

【0025】2）車輪Aの空気圧が正常でないばあい工程（a）で測定された車輪Aの空気圧と工程（c）で測定された車輪Aの角速度とを用いて表1から車輪の速度を求める。そして、表2からこの速度における各車輪の正常時における角速度比を求める。

【0026】表1から車輪Aの空気圧が正常（2.0kg/cm²）であるばあいの角速度を求める。この角速度で、

工程（a）で測定された各車輪の角速度を除して比を求め、さきほど求めた正常時における角速度と比較して、各車輪が正常であるか否かを判断することができる。

【0027】

【発明の効果】本発明はABSの車輪パルスを利用することにより、システムの信頼性を上げ、またコストを低減した。また、全車輪のうち1輪のみは空気圧検出手段によって直接に減圧を測定し、他の車輪の減圧は前記1輪の角速度または全車輪の角速度の平均値に対する各車輪の角速度の相対値を使用して検出する。このため、装置の複雑化およびコストの上昇の原因となる直接の検出手段の装着を1輪だけに止めて、全輪の減圧を含む任意の組の車輪の減圧を全て正確に検出し、警告することができる。

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(54) TIRE AIR PRESSURE ABNORMALITY DETECTING METHOD AND DEVICE THEREFOR

(57)Abstract:

PURPOSE: To enable the simultaneous abnormality detection in tire air pressure even on all wheels by comparing air pressure with the normal value on the basis of the angular velocity of each wheel and the air pressure of only one wheel, and processing angular velocity ratios between one wheel and other wheels, and the like.

CONSTITUTION: The angular velocity of each wheel is detected in a process (a), and a signal proportional to the angular velocity is generated in a process (b). The air pressure of only one wheel is directly detected in a process (c), and a signal proportional to the air pressure is generated in a process (d). Each signal is processed in a process (e). In the process (e), the air pressure of one directly-detected wheel is compared with the normal value, and when the difference is 0.3kg/cm² or more, abnormality warning is performed. At the normal time, on the other hand, the angular velocity ratios of other wheels to one wheel are compared with the normal value, and when the difference is 0.05%-0.60%, abnormality warning is performed. Or the angular velocity is compared with the average value, and when the difference is 0.05%-0.60%, abnormality warning is performed. The abnormality of tire air pressure can be thereby detected simultaneously even on all wheels.

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CLAIMS

[Claim(s)]

- [Claim 1] (a) The process which detects the angular velocity of each wheel, the process which generates the signal proportional to the angular velocity by which (b) detection was carried out, (c) The process which carries out direct detection of the pneumatic pressure of only one flower, the process which generates the signal proportional to the pneumatic pressure by which (d) detection was carried out, Consist of a process which carries out data processing of the signal emitted at said process (b) and process (d), and said process (e) is related with said one flower to which direct measurement of the pneumatic pressure is carried out, and (e) - The pneumatic pressure compares with the normal values defined beforehand, and it is 0.3 kg/cm². The equipment which will warn of the abnormalities of the tire if there is the above difference is operated. When said pneumatic pressure of one flower is normal The ratio to said angular velocity of one flower of the angular velocity about other wheels When there is always [forward] on the basis of said angular velocity of one flower in normal pneumatic pressure 0.05 to 0.60% of difference as compared with the value of a wheel angular-velocity ratio table, Or the method of detecting the abnormalities of the tire pressure of the vehicle characterized by being the process which operates the equipment which warns of the abnormalities of the tire when 0.05 to 0.60% of difference has the angular velocity as compared with the average of the angular velocity of all wheels.
- [Claim 2] The method according to claim 1 of having further the process (f) which specifies the wheel which asked for the angular velocity which is said one flower when pneumatic pressure is normal, asked for the angular-velocity ratio of other wheels to this angular velocity, and was decompressed from the table which displays the relation between pneumatic pressure and angular velocity when warned of said abnormalities of one flower.
- [Claim 3] An angular-velocity detection means to detect the angular velocity of each wheel, an angular-velocity signal generation means to generate the signal proportional to the detected angular velocity, The pneumatic pressure detection means which carries out direct detection of the pneumatic pressure of only one flower, an air pressure signal generating means to generate the signal proportional to the called-for pneumatic pressure, And it consists of a data-processing means which carries out data processing of the signal emitted from said angular-velocity signal generation means and the air pressure signal generating means. Said data-processing means is related with said one flower to which direct measurement of the pneumatic pressure is carried out. The pneumatic pressure compares with the normal values defined beforehand, and it is 0.3 kg/cm². The equipment which will warn of the abnormalities of the tire if there is the above difference is operated. When said pneumatic pressure of one flower is normal The ratio to said angular velocity of one flower of the angular velocity about other wheels When there is always [forward] on the basis of said angular velocity of one flower in normal pneumatic pressure 0.05 to 0.60% of difference as compared with the value of a wheel angular-velocity ratio table, Or equipment which detects the abnormalities of the tire pressure of the vehicle characterized by operating the equipment which warns of the abnormalities of the tire when 0.05 to 0.60% of difference has the angular velocity as compared with the average of the angular velocity of all wheels.
- [Claim 4] Equipment according to claim 3 which comes further to have a specific means to specify the wheel which asked for the angular velocity which is said one flower when pneumatic pressure is normal, asked for the angular-velocity ratio of other wheels to this angular velocity, and was decompressed from the table which displays the relation between pneumatic pressure and angular velocity when said pneumatic pressure of one flower was unusual.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the detection approach of the abnormalities in a tire pressure of vehicles, such as a passenger car and a truck, and detection equipment. In more detail, realizing low cost whenever [wheel speed / of ABS (antilock-braking-system)] using a pulse, it is the minimum increase of cost of forming pneumatic pressure detection equipment only in one flower, and is related with the approach and equipment which can also detect simple and certainly the abnormalities in coincidence of two or more flowers.

[0002]

[Description of the Prior Art] The pneumatic pressure of a tire has great effect on the engine performance of a vehicle, and especially reduction of pneumatic pressure is a problem concerning insurance. For this reason, many means to detect the abnormalities in pneumatic pressure of a tire from the former have been proposed. However, since these proposals were difficult to reconcile high-reliability and low cost on the occasion of utilization, they did not spread widely. Although the system which used the pulse whenever [wheel speed / of ABS] with the spread of ABS, and has low cost and high-reliability is proposed in recent years, although this system has dependability to the abnormalities of one flower, it has left anxiety to the abnormalities in coincidence of two or more flowers.

[0003]

[Problem(s) to be Solved by the Invention] By the way, the equipment which usually detects such abnormalities in pneumatic pressure is classified into some according to the means of detection. One is a type which detects pneumatic pressure directly, and another is a type which detects the physical quantity (the amount of deflections, rotational frequency, etc.) which changes with pneumatic pressure.

[0004] Since the former has difficult problems, such as transfer of the signal from body of revolution to a fixed side, while it is advantageous in dependability, equipment tends to become intricately and expensive. Moreover, the latter has a field lacking in dependability in instead of [simple / equipment / and cheap].

[0005] Moreover, in the system which detects the abnormalities in pneumatic pressure from such wheel speed, since abnormalities are judged whenever [wheel speed / of a normal ring] by the comparison with a pulse, and the pneumatic pressure of at least one tire must be normal, the abnormalities of all ring coincidence are usually theoretically undetectable.

[0006] In view of an above-stated situation, this invention is low cost, and is reliable, and, moreover, also aims detection of the abnormalities of all ring coincidence at offering the tire-pressure malfunction detection approach and equipment which become possible.

[0007]

[Means for Solving the Problem] The process which detects the angular velocity of (a) each wheel by this invention, the process which generates the signal proportional to the angular velocity by which (b) detection was carried out, (c) The process which carries out direct detection of the pneumatic pressure of only one flower, the process which generates the signal proportional to the pneumatic pressure by which (d) detection was carried out, Consist of a process which carries out data processing of the signal emitted at said process (b) and process (d), and said process (e) is related with said one flower to which direct measurement of the pneumatic pressure is carried out. and (e) — The pneumatic pressure compares with the normal values defined beforehand, and it is 0.3 kg/cm². The equipment which will warn of the abnormalities of the tire if there is the above difference is operated. When said pneumatic pressure of one flower is normal The ratio to said angular velocity of one flower of the angular velocity about other wheels When there is always [forward] on the basis of said angular velocity of one flower in normal pneumatic pressure 0.05 to 0.60% of difference as compared with the value of a wheel angular-velocity ratio table, Or when 0.05 to 0.60% of difference has the angular velocity as compared with the average of the angular velocity of all wheels, the method of detecting the abnormalities of the tire pressure of the vehicle which is the process which operates the equipment which warns of the abnormalities of the tire is offered.

[0008] In the approach of this invention, when warned of the abnormalities of said pneumatic pressure of one flower, it asks for the angular velocity which is said one flower when pneumatic pressure is normal from the table which displays the relation between pneumatic pressure and angular velocity, and it can ask for the angular-velocity ratio of other wheels to this angular velocity, and the decompressed wheel can be specified.

[0009] Moreover, an angular-velocity detection means by which this invention detects the angular velocity of each wheel, An angular-velocity signal generation means to generate the signal proportional to the detected angular velocity, the pneumatic pressure detection means which carries out direct detection of the pneumatic pressure of only one flower, It consists of a data-processing means which carries out data processing of the signal emitted from an air pressure signal generating means to generate the signal proportional to the called-for pneumatic pressure, said angular-velocity signal generation means, and the air pressure signal generating means. Said data-processing means is related with said one flower to which direct measurement of the pneumatic pressure is carried out. The pneumatic pressure compares with the normal values defined beforehand, and it is 0.3 kg/cm². The equipment which will warn of the abnormalities of the tire if there is the above difference is operated. When said pneumatic pressure of one flower is normal The ratio to said angular velocity of one flower of the angular velocity about other wheels When

there is always [forward] on the basis of said angular velocity of one flower in normal pneumatic pressure 0.05 to 0.60% of difference as compared with the value of a wheel angular-velocity ratio table. Or when 0.05 to 0.60% of difference has the angular velocity as compared with the average of the angular velocity of all wheels, the equipment which detects the abnormalities of the tire pressure of the vehicle which operates the equipment which warns of the abnormalities of the tire is offered.

[0010] When said pneumatic pressure of one flower is unusual, the equipment of this invention asks for the angular velocity which is said one flower when pneumatic pressure is normal from the table which displays the relation between pneumatic pressure and angular velocity, may ask for the angular-velocity ratio of other wheels to this angular velocity, and may have a specific means to specify the decompressed wheel, further.

[0011]

[Function] In this invention, by measuring the pneumatic pressure directly, reduced pressure is detected and reduced pressure is detected [wheels / other] by the relative value of the angular velocity of said one flower, or the angular velocity of each wheel to the average of the angular velocity of all wheels about one of the wheels of a vehicle.

[0012]

[Example] Hereafter, how (only henceforth the detection approach) to detect the abnormalities of the tire pressure of the vehicle of this invention is explained for every process.

[0013] In a process (a), the angular velocity of each wheel is detected from a pulse using angular-velocity detection means, such as an impulse counter, whenever [wheel speed / which is emitted from ABS]. And in a process (b), the signal which is proportional to this angular velocity using angular-velocity signal generation means, such as a D/A converter, is made to generate, and monitoring of the angular velocity of each wheel is always carried out.

[0014] In a process (c), one in all wheels is equipped with pneumatic pressure detection means, such as a pressure transducer, and the pneumatic pressure is called for. And in a process (d), the signal which is proportional to this pneumatic pressure using DC amplifier etc. is generated, and monitoring is always carried out.

[0015] The wheel A (let the wheel equipped with said pneumatic pressure detection means be Wheel A.) by which monitoring is first carried out in the (d) process in the process (e) Pneumatic pressure [being below the same] compares with the normal values defined beforehand, and it is 0.3 kg/cm². If there is the above difference, the equipment which warns of the abnormalities of the tire will be operated. Since it is measured directly, including reduced pressure of all rings of all, all reduced pressure of the group of the wheel of the arbitration containing Wheel A is detected, and it is warned of the pneumatic pressure of Wheel A. The pneumatic pressure and the rate dependency of the tire angular rate of rotation of Wheel A are shown in Table 1.

[0016]

[Table 1]

表 1

	20 (km/h)	40 (km/h)	60 (km/h)	80 (km/h)	100 (km/h)	120 (km/h)
3.0 (kg/cm ²)	8.8680 (rad/sec)	17.7340	26.5994	35.4537	44.2984	53.1033
2.6 (kg/cm ²)	8.8737	17.7436	26.6124	35.4675	44.3191	53.1361
2.3 (kg/cm ²)	8.8816	17.7595	26.6364	35.4993	44.3544	53.1715
2.0 (kg/cm ²)	8.8940	17.7835	26.6692	35.5402	44.4018	53.2213
1.7 (kg/cm ²)	8.9093	17.8121	26.7077	35.5889	44.4574	53.2811
1.4 (kg/cm ²)	8.9208	17.8351	26.7409	35.6282	44.5026	53.3238
1.0 (kg/cm ²)	8.9358	17.8600	26.7765	35.6724	44.5596	53.4004

[0017] And when reduced pressure is not accepted about Wheel A, the ratio of the angular velocity of the wheel A called for at the process (a) and the angular velocity of other wheels is called for. If there is 0.05 to 0.60% of difference as compared with the table value by which this ratio is created beforehand, the equipment which warns of the abnormalities of that tire will be operated. Moreover, if the average of the angular velocity of all the wheels called for at the process (a) is calculated and 0.05 to 0.60% of difference has the angular velocity of Wheel A as compared with this average, it is good also as operating the equipment which warns of the abnormalities of that tire. Thus, it is detected and warned of all reduced pressure of the group of the wheel of the arbitration which does not contain Wheel A.

[0018] Warning can be performed using that of which it complains to the acoustic sense of a buzzer etc., and the thing of which it complains to the vision of a lamp etc.

[0019] In a process (e), the table which defined the predetermined angular-velocity pitch and described the ratio of the angular velocity of each wheel to the angular velocity of the normal wheel A for every range of the is required, and this table can perform rectilinear-propagation real transit for every rate defined with normal pneumatic pressure, and can create it by asking for an angular-velocity ratio for every rate. The example of such a table is shown in Table 2. The forward left ring is equipped with the pneumatic pressure detection means in the example of Table 2.

[0020]

[Table 2]

表 2

	20 (km/h)	40 (km/h)	60 (km/h)	80 (km/h)	100 (km/h)	120 (km/h)
左前輪 (FL)	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
右前輪 (FR)	1.00151	1.00151	1.00152	1.00152	1.00153	1.00153
左後輪 (RL)	0.99783	0.99776	0.99767	0.99756	0.99745	0.99732
右後輪 (RR)	0.99933	0.99927	0.99918	0.99908	0.99898	0.99885

[0021] As explained above, according to the approach of this invention, what two or more wheels of the group of arbitration decompressed including reduced pressure of all four flowers is detectable. And the judgment of which wheel when reduced pressure is detected, what was decompressed is performed by using Table 1 and Table 2 together. the pneumatic pressure of the forward always of Wheel A — 2.0kg/cm² it is — the concrete example of a case of operation is shown below.

[0022] First, as mentioned above, whether Wheel A is normal measures pneumatic pressure with a pressure transducer etc., and it is judged by comparing with the normal values defined beforehand.

[0023] And when the pneumatic pressure of the 1 wheel A is normal, the rate of a vehicle is found from Table 1 using the pneumatic pressure of the wheel A measured at the process (a), and the angular velocity of the wheel A measured at the process (c). And it asks for the angular-velocity ratio in always [of each wheel in this rate / forward] from Table 2.

[0024] As compared with the angular velocity in always [forward] for which *(ed) angular velocity of each wheel measured at the process (a) with the angular velocity of Wheel A, and asked for the ratio, and it asked previously, it can judge whether each wheel is normal.

[0025] 2) When the pneumatic pressure of Wheel A is not normal, find the rate of a vehicle from Table 1 using the pneumatic pressure of the wheel A measured at the process (a), and the angular velocity of the wheel A measured at the process (c). And it asks for the angular-velocity ratio in always [of each wheel in this rate / forward] from Table 2.

[0026] It asks for angular velocity in case the pneumatic pressure of the table 1 empty-vehicle ring A is normal (2.0kg/cm²). As compared with the angular velocity in always [forward] for which *(ed) angular velocity of each wheel measured at the process (a), and asked for the ratio, and it asked previously with this angular velocity, it can judge whether each wheel is normal.

[Effect of the Invention] By using the wheel pulse of ABS, this invention raised the dependability of a system and reduced cost. Moreover, with a pneumatic pressure detection means, only one of all wheels measures reduced pressure directly, and it detects reduced pressure of other wheels using the relative value of the angular velocity of said one flower, or the angular velocity of each wheel to the average of the angular velocity of all wheels. For this reason, wearing of the direct detection means constituting complication of equipment and the cause of a rise of cost is stopped only to one flower, and all reduced pressure of the wheel of the group of arbitration including reduced pressure of all rings can be detected correctly, and it can warn of it.

[Translation done.]

